they have prepared their recent work for the engraver. The staff retained in England will have to complete the survey of the superficial deposits, which is so valuable as a basis for the agricultural valuation of land, as well as for other purposes. For some years past the mapping of these deposits has advanced simultaneously with that of the rocks underneath them. Two kinds of maps are supplied to the public, one indicating the superficial accumulations, and therefore invaluable as an agricultural map, and the other showing the "solid geology" or older rocks that lie below. The importance of mapping the superficial deposits, however, both from an industrial and scientific point of view, was not recognised until comparatively recently. Over the larger part of the country, therefore, these deposits are not expressed upon the Survey maps, and it is to the completion of this work that one part of the energy of the staff must now be directed. It will be desirable also to resume the survey of the coalfields on the cale of six inches to a mile, which has been temporarily interrupted in order to hasten the completion of the one-inch map. The South Wales coalfield, for example, was mapped some forty years ago, and so much has been done in the interval towards the development of that vast mineral basin that the maps are so antiquated as to be of comparatively little practical value. We learn from the same report that the most important work lying before the Survey in England and Wales is the geological description of the country. As the issue of explanatory pamphlets to accompany the one-inch maps was not begun until 1857, there is a large area of ground of which no published account has been given, except on the maps and sections. Printed explanations of each sheet are now to be supplied, and from these and all the data in possession of the Survey a series of Memoirs or Monographs is to be compiled which will embrace a generalised view of the geological structure and of the minerals and industrial resources of the whole country. It is the fate of geological maps, as well as of other human productions, to get out of date. As the nation has expended so ungrudgingly to carry on a Geological Survey which is acknowledged to stand at the head of the geological surveys of the world, it would be worse than folly to lose the benefit of all this expenditure by allowing the maps to become obsolete. New openings are continually being made which throw fresh light on what lies beneath us. It will be the duty of Parliament to see that a permanent staff, which need not be a large or costly one, is always retained for the purpose of keeping the maps up to date. Meanwhile it is pleasant to see that the work of this worthy national enterprise is being carried on with vigour, and that its staff are fully alive to the importance of the duties that still lie before them.

THE ORIGIN OF THE SCENERY OF THE BRITISH ISLANDS[1]

THE Scottish Highlands must be looked upon as the relics of an ancient tableland cut out of highly crumpled and plicated schists. Among the eastern Grampians large fragments of the plateau exist at heights of more than 3000 feet, forming wide undulating plains terminating here and there at the edge of precipices. In the Western Highlands, the erosion having been more profound, the ridges are narrower, the valleys deeper, and isolated peaks are more numerous. It is the fate of a tableland to be eventually cut down by running water into a system of valleys which are widened and deepened, until the blocks of ground between are sharpened into ridges and trenched into separate prominences. The Highlands present us with far advanced stages of this process. In the youngest of British tablelands—that of the volcanic region of Antrim and the Inner Hebrides—we meet with some of the earlier parts of the change. That interesting tract of our islands reveals a succession of basaltic sheets which appear to have spread over the wide valley between the Outer Hebrides and the mainland, and to have reached southwards beyond Lough Neagh. Its original condition must have been like that of the lava-fields of Idaho and Oregon—a sea-like expanse of black basalt stretching up to the base of the mountains. What may have been the total thickness of basalt cannot be told; but the fragment remaining in Ben More, Mull, is more than 3000 feet thick. So vast has been the erosion since older Tertiary time that the volcanic plateau has been trenched in every direction by deep glens and arms of the sea, and has been reduced to detached islands. It is strange to reflect that all this revolution in the topography has been effected since the soft clays and sands of the London Basin were deposited.

The intimate relation of a system of valleys to a system of drainage lines, first clearly enunciated by Hutton and Playfair, has received ample illustrations from all parts of the world. Yet the notion is not yet extinct that in some way or other valleys have been as much, if not more, determined by subterranean lines of dislocation as by superficial erosion. Some favourite dogmas die hard, and though this dogma of fracture has been demolished over and over again, it every now and then reappears, dressed up anew as a fresh contribution to scientific progress. We have only to compare the surface of a much dislocated region with its underground structure, where that has been revealed by mining operations, as in our coal-fields, to see that valleys comparatively seldom, and then only as it were by accident, run along lines of dislocation, but that they everywhere cut across them, and that faults rarely make a feature at the surface, except indirectly by bringing hard and soft rocks against each other.

In Britain, as in other countries, there is a remarkable absence of coincidence between the main drainage system and the geological structure of the region. We may infer from this fact that the general surface, before the establishment of the present drainage system, had been reduced to a base-level of denudation under the sea, the original inequalities of configuration having been planed off irrespective of structure; or at least, that the present visible rocks were buried under a mass of later unconformable and approximately level strata, on the unequally upraised surface of which the present drainage system began to be traced. Where the existing watershed coincides generally with the crest of an anticline, its position has obviously been fixed by the form of the ground produced by the plication, though occasionally an anticline may have been deeply buried below later rocks, the subsequent folding of which along the same line would renew the watershed along its previous trend. Where drainage lines coincide with structure, they are probably, with few exceptions, of secondary origin; that is, they have been developed during the gradual denudation of the country. Since the existing watershed and main drainage lines of Britain are so independent of structure, and have been determined chiefly by the configuration of the surface when once more brought up within the influence of erosion, it may be possible to restore in some degree the general distribution of topography when they were begun.

One of the most curious aspects of the denudation of Britain is its extraordinary inequality. In one region the framework of the land has been cut down into the very Archæan core, while in the immediate vicinity there may be many thousands of feet of younger strata which have not been removed. This inequality must result from difference in total amount of upheaval above the base-line of denudation, combined with difference in the length of exposure to denudation. As a rule the highest and oldest tracts will be most deeply eroded. Much of the denudation of Britain appears to have been effected in the interval between the close of the Carboniferous and end of the Triassic period. This was a remarkable terrestrial interval, during part of which the climate was so arid that salt lakes were formed over the centre of England. Yet the denudation ultimately accomplished was enormous, thousands of feet of Carboniferous rock being entirely removed from certain areas, such as the site of the present Bristol Channel. An interesting analogy to this condition of things is presented by the Great Basin and adjoining tracts of Western America, where at the present time great aridity and extensive salt-lakes are accompanied by great erosion.

This deeply-eroded post-Carboniferous land was eventually screened from further degradation, either by being reduced through denudation to a base-level or by being protected by submergence. It was to a large extent covered with Secondary rocks, though the covering of these may have been but thin over what are now the higher grounds. The present terrestrial areas emerged at some period later than the Chalk. In England there were three tracts of land—Wales, the Pennine Chain, and the Lake District. The eastern half of the country, covered with Secondary rocks, was probably the last portion to be uplifted above the sea; hence the watersheds and drainage lines in that tract may be regarded as the youngest of all.

The history of some of the valleys of the country tells the story of the denudation. The Thames is one of the youngest

[1] Abstract of the third of a course of lectures given at the Royal Institution, February 19, by Archibald Geikie, F.R.S., Director-General of the Geological Survey. Continued from p. 348.

rivers, dating from the time when the Tertiary sea-bed was raised into land. Originally its source probably lay to the west of the existing Jurassic escarpment of the Cotswold Hills, and it flowed eastward before the Chalk escarpment had emerged. By degrees the Chalk downs have appeared, and the escarpment has retreated many miles eastward. The river, however, having fixed its course in the Chalk, has cut its way down into it, and now seems as if it had broken a path for itself across the escarpment. As all the escarpments are creeping eastward, the length and drainage area of the Thames are necessarily slowly diminishing. The Severn presents a much more complex course; but its windings across the most varied geological structure are to be explained by its having found a channel on the rising floor of Secondary rocks between the base of the Welsh hills and the nascent Jurassic escarpments. The Wye and Usk afford remarkable examples of the trenching of a tableland. The Tay and Nith are more intricate in their history. The Shannon began to flow over the central Irish plain when it was covered with several thousand feet of strata now removed. In deepening its channel it has cut down into the range of hills north of Limerick, and has actually sawn it into two.

SCIENTIFIC SERIALS

THE *American Journal of Science*, January, 1884.—The effect of a warmer climate on glaciers, by Capt. C. E. Dutton. The author fully discusses the theory of those who argue that the more copious snowfall required for a more extended system of glaciation implied more atmospheric moisture, greater evaporation, and a generally higher temperature; in fact, a warmer climate than at present, due probably to a greater rate of solar radiation. He concludes that the possibility of obtaining a greater snowfall by a warmer climate would be necessarily limited to the Arctic regions, or to altitudes far above the present snow line. Elsewhere a higher temperature would add to the rainfall, and actually diminish the snowfall. The advocates of the theory have failed to perceive that the additional moisture postulated could fall only as rain. Not until the air has discharged as rain all the moisture in excess of the quantity which saturates it at zero, can it begin to yield snow.—On the application of Wright's apparatus for distilling, to the filling of barometer tubes (one illustration), by Frank Waldo.—Account of a new method of measuring the energy expended on or rendered by a dynamo or a magneto machine in connection with the production of electricity in a large way, by C. F. Brackett.—On some points in climatology: a rejoinder to Mr. Croll, by Simon Newcomb. The assumed lower mean temperature of the northern hemisphere at some former geological epoch is attributed by Mr. Croll to a greater eccentricity of the earth's orbit, combined with a position of the perihelion near the northern solstice, causing a short perihelion summer and a correspondingly long aphelion winter. To this the author replies that too little is known of the laws of terrestrial radiation of heat through the atmosphere to justify the establishment of any theory of the glacial epoch, and that, in any case Mr. Croll fails to show why the mean temperature should be different at the supposed periods. Hence the conclusion, not that Mr. Croll's theory is false, but that it is not proven.—An account of some recent methods of photographing the solar corona without an eclipse, and of the results obtained (one illustration), by Dr. W. Huggins.—Elliptical elements of comet 1882 I., by F. J. Parsons.—The Minnesota Valley in the Ice Age, by Warren Upham.—On the so-called dimorphism in the genus Cambarus, by Walter Faxon.—Evolution of the American trotting horse, by Francis E. Nipher. In reply to the criticism of Mr. W. H. Pickering, the author argues that the known facts are not opposed to the conclusion that the trotting horse may finally trot his mile in about the same time that the running horse will cover the same distance.—On the origin of jointed structure, by G. N. Gilbert.—A theory of the earthquakes of the Great Basin, by the same author.

Revue d'Anthropologie, tome vi. fasc. 4, Paris, 1883.—The larger portion of this number is devoted to M. Mathias Duval's lecture on Transformism, of which two parts have already appeared in the earlier fascicules of the *Revue* for 1883. For English readers generally the address lacks the interest of novelty, as it is little more than an exposition of the works and opinions of Darwin and of the principal authorities, chiefly English, whose observations corroborate his views. It is satisfactory, however, to find that, while maintaining with patriotic zeal Lamarck's claim to be regarded as the originator of the theory of evolution, M. Duval recognises in Darwin the one man who, through varied yet profound scientific acquirements, intellectual qualifications, and special personal and social conditions, was alone capable of giving to novel conclusions of such extraordinary significance the authoritative force and stability of a true science.—On so-called Wormian or supernumerary bones in domestic animals, by M. Cornevin, Professor in the Lyons Veterinary College. The author finds that while in man such bones are generally cranial, in animals they are facial, and he believes himself justified in drawing from his observations two important conclusions (which, however, need support) that in animals the Wormians appear some time after birth, developing more and more with age, and that they are of frequent occurrence in the less carefully bred races, while they are very rarely found in the high breeds of horses, oxen, sheep, pigs, &c.—On the Kalmuks, by M. Deniker. The author, who is a native of the regions which he describes, has made the presence of an encampment of Kalmuks in the "Jardin d'Acclimatation," at Paris, the occasion for bringing together all the most reliable historical, geographic, ethnic, and socio-physical data in connection with this people, whose various migrations, including their great exodus from the region of the Volga in the eighteenth century, he treats at great length. He considers the oblique opening of the eye, which most writers accept as an ethnic characteristic, as of little scientific value, since it is not of specially frequent occurrence among pure Mongols such as are the Kalmuks; but he recognises, on the other hand, that such an ethnological peculiarity is to be found in a peculiar introversion of the upper eyelid which in young Kalmuk children has often the effect of obliterating the eyelashes; while the general narrowness of the opening imparts a triangular form to the eye. Black, scantily developed hair, dark brown eyes, slightly yellow skin, and a stature somewhat below the mean (the adult Kalmuk presenting the proportions of Europeans of thirteen to fourteen years of age), constitute the chief physical characteristics of the Mongol race. The paper, which is illustrated by an admirable map of the Kourghees and Kirghees territories of South Russia and West Thibet, will be continued in a subsequent number.

Journal of the Russian Chemical and Physical Society, vol. xv. fasc. 7.—On the relations between the refracting power and the chemical constitution, by S. Kanonnikoff.—On the velocities of chemical reactions, by A. Potylitzin. The thermo-chemical equivalents obtained separately for several pairs of elements allow to foresee only the direction which will be taken by the reaction when they are brought together; the heat disengaged by one pair of elements brought into reaction in the presence of other bodies, which are also liable to chemical modifications, is not equal to the whole of the thermo-chemical work of the pair, a part of it being employed for chemical work in the accessory bodies; the thermo-chemical equivalents are proportionate to the velocities during the first moments of the reaction.—Sketch of the present state of the theory of explosive substances, by S. Tcheltsoff. The actual tendency of the technics to substitute determined chemical combinations, instead of the mixtures which were used at first as explosives, is quite rational. Not only the decomposition goes on with more regularity in a chemical compound, but also the potential energy is greater.—On the chloride of pyrosulphuryl, by D. Konovaloff.—On the cause of the changes in the galvanic resistance of selenium under the influence of light, by N. Hesehus. The author concludes in favour of the dissociation transmitted into the interior of the body as the cause of this change, and, following the hints of Messrs. Bidwell and Siemens, tries to prove it by mathematical arguments.—Notes on radiophony, by M. Geritch; and on resounding tubes, by M. Bachmetieff.

Zeitschrift für wissenschaftliche Zoologie, vol. xxxix. Part 2, November 6, 1883, contains:—Researches on the brain structures in Petromyzons, by Dr. F. Ahlborn (plates 13-17). A very excellent and detailed memoir, based chiefly on the brain in *Petromyzon planeri* and *P. fluviatilis*.—On the biology and anatomy of Clione, by N. Nassonow, assistant in the Zoological Museum of Moscow (plates 18 and 19). These investigations were carried on at the biological station at Sebastopol, and on an apparently new form called *C. stationis*, found in the shells of *Ostrea adriatica*, in it the oscula are prominent orange-coloured. Branching plasmodia were traced through the shell-structure, reminding one of the mycelial threads of a fungus.—Contributions to the histology of the Echinoderms, by Dr. Otto Hamann